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ISSN 0149-175X
Texas Tech Press
Lubbock, Texas 79409

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NUMBER 88

7 OCTOBER 1983

REDESCRIPTION OF
CENTRUROIDES TESTACEUS (DEGEER) AND
DESCRIPTION OF A NEW SPECIES FROM THE
LESSER ANTILLES (SCORPIONES: BUTHIDAE)

W. DAVID SISSOM AND OSCAR F. FRANCKE

Scorpio testaceus DeGeer was described in 1778 from specimens collected in "Amérique," and since that time references to that species have appeared many times in the literature. Thorell (1877) placed it in the genus *Centrurus* (= *Centruroides* Marx) but did not report a locality for the specimens he examined. Subsequent authors reported *C. testaceus* from Montserrat (Pocock, 1893), Hispaniola (Haiti) (Roewer, 1943), and southern Florida (Banks, 1900). The record for Florida has been discredited (Gertsch and Sologlad, 1966; Muma, 1967). Kraepelin (1895, 1899) considered *Tityus serenus* Koch (distribution unknown) and *Tityus griseus* Koch (from St. Thomas, U.S. Virgin Islands) to be synonyms of *C. testaceus*. Koch's specimen of *T. griseus* was recently examined, and Kraepelin's synonymy shown to be incorrect (Francke and Sissom, 1980).

Meise (1934) transferred all members of *Centruroides* to *Rhopalurus* Thorell and recognized four polytypic species, one of which was *R. testaceus*. A new subspecies, *R. testaceus exsul* Meise, was described from the Galápagos Islands. Hoffmann (1939) relegated all species to their former status, and *C. exsul* has subsequently been considered a valid species (Mello-Leitão, 1945; Kinzelbach, 1973). We have examined some specimens of *C. exsul* and agree with those authors; further, *C. exsul* does not appear to be closely related to *C. testaceus*, based on differences in carinal morphology

of the pedipalps and metasoma, granulation of the mesosomal tergites, and morphometry.

We have been able to locate and examine the following material previously referred to as *Centruroides testaceus*: the two available syntypes of *Scorpio testaceus* DeGeer, Pocock's specimens from Montserrat, and Roewer's specimen from Haiti. In addition we have examined material from the nearby islands of Guadeloupe, St. Kitts, Nevis, Les Saintes, La Desiderade, and Marie Galante. Attempts to locate the type of *Tityus serenus* Koch have failed; Dr. W. R. Lourenço, who is currently studying that genus, informs us that the specimen is probably lost (personal communication). Likewise, we have been unable to locate Thorell's specimen(s).

Examination of the above specimens indicates that two distinct species are involved; in this paper their status is clarified. The material from the various islands is described as a new species, and the identity of the syntypes of *C. testaceus* is established. The specimen from Haiti studied by Roewer (1943), is a juvenile male (not a female as indicated by that author), most similar to the new species described below. However, in the genus *Centruroides*, juveniles of closely related species are very difficult to distinguish; thus, we are uncertain about the specific identity of the juvenile male from Haiti. Repositories for type material and specimens examined are referred to in the text by institutional acronyms, a key to which appears in the acknowledgments section.

***Centruroides pococki*, new species**
(Figs. 1-9)

Centruroides testaceus: Thorell, 1877:160 (in part ?); Kraepelin, 1891:130 (misidentification), 1895:95 (misidentification), 1899:91 (misidentification); Pocock, 1893:389, pl. 30, figs. 11, 11a (misidentification); Waterman, 1950:168 (misidentification).

Rhopalurus testaceus: Meise, 1934:30-36 (misidentification).

Centruroides testaceus: Werner, 1934:274 (misidentification); Francke, 1978:70 (misidentification); Schawaller, 1979:14 (misidentification); Francke and Sissom, 1980:1 (misidentification).

Centruroides testaceus: Stahnke and Calos, 1977:112, 117, 119 (misidentification); Stahnke, 1978:280 (misidentification).

Centruroides sp.: Armas, 1982:7

Type data.—Adult male holotype, cat. no. RS-6234, from Guadeloupe, "dans un îlot, côte sous le vent sous les galets des plages," 1-II-1963 (J. L. Raton); deposited MNHN, Paris.

Distribution.—Known from the Lesser Antillean islands of St. Kitts, Nevis, Montserrat, Guadeloupe, Les Saintes, La Desiderade, and Marie Galante.

Etymology.—The specific name is a patronym honoring Mr. R. I. Pocock for his contributions to scorpion systematics.

Diagnosis.—Adults 65-75 mm in length. Golden brown with variable underlying fuscidity; pedipalp fingers and distal segments of metasoma brownish. Tergites I-VI monocarinate, VII pentacarinate, all carinae strong. Sternite VII weakly tetracarinate. Pectinal tooth count in males 20-23 (mode 22), in females 19-22 (mode 20). Metasomal carinae moderate on I-IV in both sexes. Telson with subaculear tubercle weak to obsolete. Pedipalp chela fixed finger with eight rows of denticles (Fig. 3), movable finger with eight rows of denticles and a short apical row of four denticles (Fig. 4); inner and outer supernumerary granules present on both fingers. Ratio of metasoma V length to carapace length averaging 1.43 (range = 1.36-1.48, $N = 9$) in males, 1.10 (range = 1.06-1.13, $N = 12$) in females. Ratio of fixed finger length to carapace length averaging 0.99 (range = 0.93-1.06, $N = 22$).

Description.—The following description is based on males; parenthetical statements refer to females. Measurements of the holotype male and a paratype female appear in Table 1.

Prosoma. Carapace: anterior margin emarginate. Anterior median furrow moderately wide, deep; posterior median furrow wide, deep; posterior lateral furrows wide, deep, curved; other furrows inconspicuous. Superciliary, lateral ocular, central ocular, and posterior median carinae moderate, coarsely granular; other carinae less distinct. Interocular region densely and coarsely granular; remainder of carapace with less dense, coarse granulation. Sternum: subtriangular, with deep anteriorly directed Y-shaped longitudinal furrow.

Mesosoma. Pretergites shagreened; post-tergites coarsely granular. Median longitudinal carina on tergites I-II (I-III) moderate, coarsely granular; on III-VI (IV-VI) strong, coarsely granular. Tergite VII pentacarinate: median carina strong, granular; submedian and lateral carinae strong, coarsely granular. Venter: genital operculum completely divided longitudinally, genital papillae small (absent). Pectinal basal piece with median depression (large median depression and two small elliptical lateral depressions); pectinal tooth count 20-23, mode 22 (19-22, mode 20). Sternites III-VI smooth; sternite VII tetracarinate, submedian and lateral carinae moderate (weak), finely serrate.

Metasoma. Segments I-IV: All carinae moderate. Dorsolateral carinae on I finely serrate, converging posteriorly; on II-III finely serrate (serratocrenulate); on IV crenulate. Lateral supramedian carinae on I finely serrate (serratocrenulate); on II finely serrate to crenulate (serratocrenulate); on III-IV weakly crenulate (serrato-

TABLE 1.—Measurements (in mm) of *Centruroides testaceus* (DeGeer) and *Centruroides pococki*, new species.

	<i>C. testaceus</i>	<i>C. pococki</i>	
	lectotype	holotype ♂	paratype ♀
Total length	66.5	71.0	67.7
Carapace length	6.3	6.2	7.2
Mesosoma length	16.5	18.8	20.2
Metasoma length	36.8	38.9	32.7
I length/width	5.5/3.4	6.0/2.6	5.1/3.3
II length/width	6.8/3.3	7.3/2.5	6.1/3.2
III length/width	7.4/3.1	7.8/2.4	6.4/3.2
IV length/width	8.3/2.9	8.5/2.4	7.1/3.1
V length/width	8.8/2.8	9.3/2.5	8.0/3.1
Telson length	6.9	7.1	7.6
Vesicle length	4.1	5.2	4.8
width	2.3	2.5	2.7
depth	2.2	2.2	2.4
Aculeus length	2.8	2.3	3.2
Pedipalp length	25.4	25.3	27.1
Femur length	6.2	6.6	7.0
width	1.6	1.5	1.8
Tibia length	7.2	7.2	7.6
width	2.3	2.1	2.5
Chela length	12.0	11.5	12.5
width	2.6	2.6	2.8
depth	2.9	2.6	2.9
Movable finger length	7.3	7.1	8.2
Fixed finger length	6.6	6.2	7.2
Pectinal teeth (left-right)	28-28	22-23	21-21

crenulate). Lateral inframedian carinae on I complete, finely serrate; on II-IV absent. Ventrolateral carinae on I finely serrate (serratocrenulate); on II-IV weakly crenulate (crenulate). Ventral submedian carinae on I finely serrate; on II finely serratocrenulate; on III-IV crenulate. Intercarinal spaces of segments I-IV with coarse granulation. Segment V (Figs. 6, 8): Dorsolateral and lateral median carinae obsolete; on some specimens very weak, granular. Ventrolateral carinae weak, granular. Ventromedian carina moderate, weakly crenulate (crenulate). Intercarinal spaces with dense coarse granulation.

Telson (Figs. 7, 9). Vesicle less than twice as long as wide; moderately slender (moderately globose); ventral surface granular (densely granular); subaculear tubercle weak, vestigial, or obsolete. Aculeus length approximately 0.50 (0.65) that of vesicle length, moderately (sharply) curved.

Chelicera. Dentition typical of genus; basalmost tooth of movable cheliceral finger sometimes reduced.

Pedipalp. Femur: tetracarinate, with all carinae moderate. Dorsointernal carina serratocrenulate (crenulate); dorsoexternal carina serratocrenulate (serratocrenulate to serrate); ventrointernal carina crenulate (serratocrenulate); ventroexternal carina serrate (serratocrenulate). Internal face with row of large conical granules. Orthobothriotaxia "A" (Vachon, 1974).

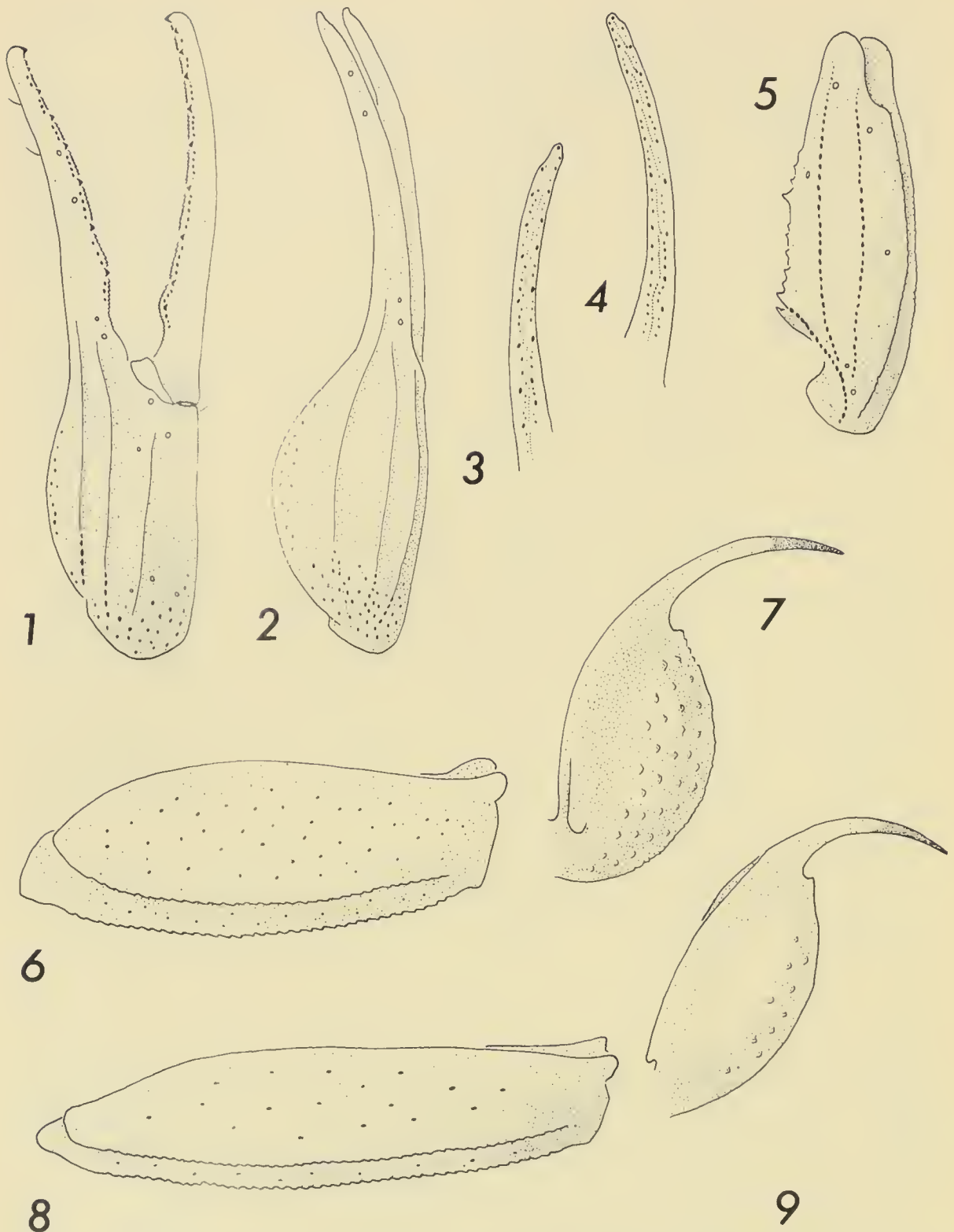
Tibia (Fig. 5): hexacarinate, all carinae moderate. Dorsointernal carina crenulate; dorsomedian, dorsoexternal, and external carinae weakly crenulate; ventrointernal carina granular; ventroexternal carina weakly crenulate. Internal face with row of large conical granules. Orthobothriotaxia "A" (Vachon, 1974).

Chela (Figs. 1-4): Fixed finger (Fig. 3) with eight oblique rows of granules; movable finger (Fig. 4) with eight oblique rows of granules plus a short apical row of four granules; supernumerary granules present in later instars, absent in early instars. Fingers moderately scalloped basally. Dorsal marginal carina moderate (weak), granular basally, smooth to granular distally. Dorsal secondary carina moderate (weak), granular basally, smooth to granular distally. Digital carina moderate, granular basally, smooth to granular distally. External secondary carina weak, granular. Ventroexternal carina moderate, smooth to granular. Ventrointernal carina weak, smooth. Internal surface with numerous small, sharp granules. Orthobothriotaxia "A" (Vachon, 1974).

Coloration. Carapace and tergites golden brown; lateral eyes and ocular tubercle black; chelicerae creamy white. Metasoma golden brown, in many specimens gradually becoming orange brown distally; telson golden brown to orange brown. Pedipalps: femur, tibia, and chela manus golden brown; chela fingers dark brown. Legs yellow. Carapace, chelicerae, tergites, metasoma, pedipalps, and legs with variable underlying fuscidity.

Variation.—The following characters were found to be markedly variable among adults in *C. pococki*: (1) coloration, (2) pectinal tooth counts, and (3) the size of the subaculear tubercle. Coloration differs primarily in the amount of underlying fuscidity. There is a gradation from an almost immaculate condition to one of rather dense fuscidity.

Pectinal tooth counts in males were found to vary as follows: 3 combs with 20 teeth (15%); 2 combs with 21 teeth (10%); 8 combs with 22 teeth (40%); and 7 combs with 23 teeth (35%). Pectinal tooth counts in females were found to vary as follows: 1 comb



FIGS. 1-9.—External anatomy of *Centruroides pococki*, new species: 1, external aspect of right pedipalp chela; 2, dorsal aspect of right pedipalp chela; 3, dentate margin of fixed finger; 4, dentate margin of movable finger; 5, dorsal aspect of right pedipalp tibia; 6, lateral aspect of metasomal segment V of female; 7, lateral aspect of telson of female; 8, lateral aspect of metasomal segment V of male; 9, lateral aspect of telson of male.

with 19 teeth (3.6%); 14 combs with 20 teeth (50%); 9 combs with 21 teeth (32.1%); and 4 combs with 22 teeth (14.3%).

The subaculear tubercle varies from obsolete to weak among specimens examined. In addition, the shape of the telson (Figs. 7,

9) and the lengths of the metasomal segments (Figs. 6, 8, Table 1) were found to be sexually dimorphic, as is typical of other *Centruroides*. Juveniles differ from adults by being very pale yellow with stronger underlying fuscosity and by lacking the characteristics of sexual dimorphism discussed above.

Comparisons.—*C. pococki* is most similar to *C. testaceus* (DeGeer), with which it has been confused in the past. From that species it differs markedly in pectinal tooth counts (in *C. pococki*, males range from 20-23 in this character and females from 19-22; the lectotype and only known specimen of *C. testaceus*, a female, has a count of 28-28). In *C. pococki* the ventrolateral and ventral submedian carinae of the metasoma are moderate, in *C. testaceus* they are weak. The shape of the telson also differs (see Figs. 7, 16), being more globose in *C. pococki*. Finally, the metasomal segments of *C. testaceus* are proportionately longer than those of *C. pococki*: the female of *C. testaceus* has a metasomal segment V length/carapace length ratio of 1.40; in females of *C. pococki* this ratio ranges from 1.06-1.13. *Centruroides pococki* may also be easily distinguished from *Centruroides hasethi* Pocock by its lower pectinal tooth counts.

Specimens examined.—LESSER ANTILLES: *Saint Kitts*: Old Bay Road, April 1969 (F. D. Bennett, 4 ♂♂, 3 ♀♀, 7 juv. (ENKW-604) (FSCA); Brimstone Hill, 13 April 1967 (F. D. Bennett and R. Yearwood), 1 ♀ (ENKW-462) (FSCA), 21 June 1967 (F. D. Bennett, K. Lawrie, and J. Phillips), 1 ♂, 4 ♀♀ (ENKW-490) (FSCA); *Nevis*: Indian Castle, 20 November 1967 (F. D. Bennett), 1 ♀, 1 juv. (ENKW-601) (FSCA); *Montserrat*: no date (no collector), 3 ♂♂, 2 ♀♀ (BMNH); *Guadeloupe*: Anse-a-l'eau (bajo piedras), 3 March 1975 (F. Chalumeau), 1 ♂, 2 ♀♀ (ACC IZ), 18-I-1977 (F. Chalumeau), 1 ♀ (RS-8121), 1 juv. (RS-8118) (MNHN); "Dans un îlot, côte sous le vent sous les galets des plages", 1-II-1963 (J. L. Raton), 1 holotype ♂, 1 ♂, 2 ♀♀ (RS-6234) (MNHN); Grandes Salines, Pointe des Chateaux (sous pierres.), 10-XII-1978 (J. d'Aguilar), 1 ♂, 1 ♀ (RS-7334) (MNHN); Grande Terre, La Grande Vigie (sus le picore en sus bois), 17-IV-1979 (J.-P. Mauries), 1 ♀, 1 juv. (RS-7376) (MNHN); Pte. de la Grande Vigie ("cause" tres sec a "Crabes"), 3 Juin 1978 (J.-P. Mauries), 1 ♀, 1 juv. (RS-7284) (MNHN); St. François, Pte. des Chateaux [pres croix (sous pierre.) très sec.], 6 Juin 1978 (J.-P. Mauries), 1 ♀ (RS-7282) (MNHN); *Les Saintes*: Terre de Haut, Le Chameau (309 m), 17 Juin 1978 (J.-P. Mauries), 1 ♂, 1 ♀, 1 juv. (RS-7283) (MNHN), Terre de Haut, 6-III-1976 (F. Chalumeau), 1 ♂ (RS-8119) (MNHN); *Marie Galante*: Capestere les Galets, 5-11-1978 (Chalumeau), 3 ♀♀ (RS-8336) (MNHN).

Centruroides testaceus (DeGeer)

(Figs. 10-17)

Scorpio testaceus DeGeer, 1778:347, pl. 41, fig. 11.

Centrurus testaceus: Thorell, 1877:160 (in part); *nec* Kraepelin, 1891:130, 1895:95, 1899:91; *nec* Pocock, 1893:389; *nec* Banks, 1900:425; *nec* Waterman, 1950:168; Gertsch and Sologlad, 1966:1.

Centruro testaceo: Karsch, 1879:120.

Rhopalurus testaceus: *nec* Meise, 1934:30-36.

Centruroides testaceus: *nec* Werner, 1934:274; Hoffmann, 1939:322, 324; *nec* Roewer, 1943:219; Bücherl, 1971:327; *nec* Francke, 1978:70; *nec* Schawaller, 1979:14; *nec* Francke and Sissom, 1980:1; Armas, 1982:7.

Centruroides testaceus (*sic*): *nec* Muma, 1967:16; *nec* Stahnke and Calos, 1977:112, 117, 119; *nec* Stahnke, 1978:280.

Type data.—DeGeer (1778) described *Scorpio testaceus* from at least two specimens. We have examined the two available syntypes (a female and a male) and they are not conspecific. Whereas the original description applies to both specimens, the female is illustrated (1778:pl. 41, fig. 11) and is presently in better condition than the male. For these reasons, the female is hereby designated lectotype. Both specimens are dried and pinned. The lectotype female and the unidentified male are deposited in NHR, Stockholm.

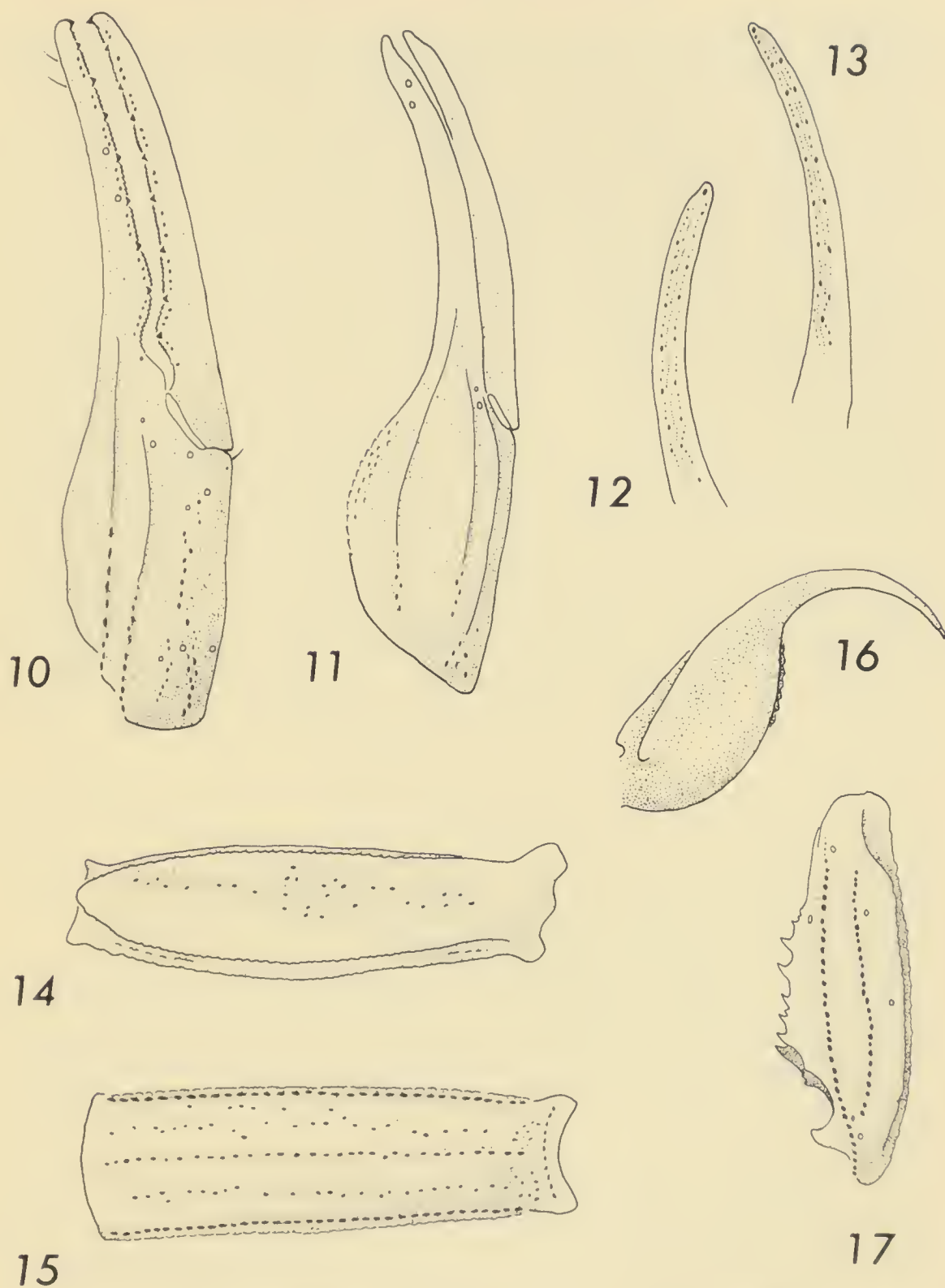
Distribution.—Known only from “Amérique”.

Diagnosis.—Based on adult female lectotype. Total length 66.5 mm. Present coloration golden brown, immaculate. Tergites I-VI monocarinate, VII pentacarinate, all carinae strong. Sternites III-VI acarinate, VII weakly tetracarinate. Pectinal tooth count 28. Ventrolateral and ventral submedian carinae of metasoma weak, others moderate. Telson (Fig. 16) with ventral row of small granules, lacking definite subaculear tubercle. Pedipalp chela fixed finger with eight rows of denticles, movable finger with eight rows of denticles and short apical row of four denticles; inner and outer supernumerary granules present on both fingers. Ratio of metasoma V length to carapace length 1.40; of fixed finger length to carapace length 1.05.

Description.—The following description is based on the female lectotype. Measurements appear in Table 1.

Prosoma. Carapace: anterior margin moderately notched. Anterior median furrow moderately wide, deep; posterior median furrow wide, deep; posterior lateral furrows wide, deep, curved; other furrows inconspicuous. Superciliary, lateral ocular, and posterior median carinae moderate, coarsely granular; central lateral carinae moderately strong, coarsely granular; other carinae poorly defined. Interocular region densely and coarsely granular; remainder of carapace with scattered, coarse granulation. Sternum: subtriangular, with deep anteriorly directed Y-shaped longitudinal furrow.

Mesosoma. Pretergites shagreened; post-tergites coarsely granular. Median longitudinal keel on tergites I-III weak, coarsely



FIGS. 10-17.—External anatomy of *Centruroides testaceus* (DeGeer): 10, external aspect of right pedipalp chela; 11, dorsal aspect of right pedipalp chela; 12, dentate margin of fixed finger; 13, dentate margin of movable finger; 14, lateral aspect of metasomal segment V; 15, ventral aspect of metasomal segment V; 16, lateral aspect of telson; 17, dorsal aspect of right pedipalp tibia.

granular; on IV-VI moderate, coarsely granular. Tergite VII pentacarinat: median keel moderate, granular; submedian keels moderate, crenulate; lateral keels moderate, crenulate. Venter: Genital operculum of lectotype damaged. Pectines with basal piece twice

as broad as long, with two small lateral depressions; pectinal tooth count 28-28. Sternites III-VI smooth; sternite VII tetracarnate, submedian and lateral carinae weak, finely granular.

Metasoma. Segments I-IV: dorsolateral carinae on I moderate, finely crenulate, converging posteriorly; on II moderate, crenulate; on III-IV weak, finely crenulate to granular. Lateral supramedian carinae on I moderate, finely crenulate; on II moderate, crenulate; on III-IV weak, finely crenulate. Lateral inframedian carinae on I moderate, complete, granular to finely crenulate; on II-IV absent. Ventrolateral carinae on I weak, smooth on anterior one-half, finely granular on posterior one-half; on II-IV weak, finely crenulate. Ventral submedian carinae on I weak, smooth; on II weak, smooth on anterior one-half, finely crenulate on posterior one-half; on III-IV weak, finely crenulate. Dorsal face of segment IV with strong median longitudinal furrow; other intercarinal spaces of segments I-IV shagreened. Segment V (Figs. 14, 15): Dorsolateral, lateromedian, and ventrolateral carinae weak, granular; ventromedian carina moderate, granular. Ventral and lateral faces with fine granulation, dorsal face with moderate median longitudinal furrow.

Telson (Fig. 16). Vesicle less than twice as long as wide; moderately compressed dorsoventrally; ventral surface with row of small granules medially; no definite subaculear tubercle. Aculeus long, about two-thirds length of vesicle, sharply curved.

Chelicera. Dentition typical of genus.

Pedipalp. Femur: tetracarnate. Dorsointernal and dorsoexternal carinae moderate, granular to crenulate; ventrointernal and ventroexternal carinae moderate, serrate. Internal face set with a row of large conical granules. Orthobothriotaxia "A" (Vachon, 1974).

Tibia (Fig. 17): hexacarnate. Dorsointernal and dorsal median carinae moderate, granular. Dorsoexternal, external, ventrointernal, and ventroexternal carinae weak, granular. Internal face set with a row of large conical granules. Orthobothriotaxia "A" (Vachon, 1974).

Chela (Figs. 10-13): fixed finger (Fig. 12) with eight oblique rows of granules; movable finger (Fig. 13) with eight oblique rows of granules plus a short apical row of four granules; supernumerary granules present. Fingers moderately scalloped. Dorsal marginal carina weak to moderate; granular basally, smooth distally. Dorsal secondary and digital carinae moderate, granular basally, smooth distally. External secondary carina weak, granu-

lar. Ventroexternal carina moderate, smooth. Ventrointernal carina weak, granular. Internal surface of hand with numerous small, sharp granules. Orthobothriotaxia "A" (Vachon, 1974).

Coloration. The lectotype is a dry, pinned specimen and, therefore, its present coloration is unreliable. However, it appears that the specimen was uniformly colored, lacking the dark dorsal stripes characteristic of many species of the genus. There is also no suggestion of dusky markings on the legs, pedipalps, or body, or of darkening of the pedipalp chelae fingers; however, such markings are probably more subject to fading than dark dorsal stripes.

Comparisons.—*Centruroides testaceus* is similar to *C. hasethi* Pocock and *C. pococki* Sissom and Francke. It differs from *C. hasethi* by having a thinner and longer metasoma. The ratio of caudal segment V length/width is less than 2.40 in females of *C. hasethi*, 3.14 in *C. testaceus*; the ratio of caudal segment IV length/width is greater than 2.25 in females of *C. hasethi*, 2.86 in *C. testaceus*. Comparisons of *C. testaceus* to *C. pococki* appear in the appropriate section under the latter's description.

Specimens examined.—The lectotype female.

ACKNOWLEDGMENTS

We wish to express our gratitude to T. Kronestedt of the Naturhistoriska Riksmuseet (NHR), Stockholm, for allowing us to examine the syntypes of *Scorpio testaceus* DeGeer. We would also like to thank the following curators and institutions for providing and searching for specimens in their collections (including the type of *Tityus serenus* Koch): L. F. de Armas, Academia de Ciencias de Cuba, Instituto de Zoologia (ACC/IZ), Havana; G. B. Edwards, Florida State Collection of Arthropods (FSCA), Gainesville; O. Elter, Museo ed Istituto di Zoologia Sistemica della Universita di Torino (TOR), Torino; M. Grasshoff, Natur-Museum und Forschungsinstitut Senckenberg, Frankfurt; J. Gruber, Naturhistorisches Museum, Wien; A. Kolb, Biologisches Institut, Bamberg; W. R. Lourenço, Muséum national d'Histoire naturelle (MNHN), Paris; M. Moritz, Zoologisches Museum der Humboldt Universität, Berlin; N. I. Platnick, American Museum of Natural History, New York; W.J. Pulawski, California Academy of Sciences, San Francisco; G. Rack, Zoologisches Institut und Zoologisches Museum, Hamburg Universität, Hamburg; J. R. Reddell, Texas Memorial Museum, the University of Texas, Austin; H. W. Waldén, Naturhistoriska Museet, Göteborg; F. R.

Wanless and P. Hillyard, British Museum (Natural History) (BMNH), London. We sincerely thank them all for their efforts.

In addition we thank J. C. Cokendolpher and W. R. Lourenço for their comments on the manuscript, and L. A. Prien for typing the manuscript. This research was supported in part by the Institute for Museum Research, Texas Tech University.

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Addresses of authors: W. D. SISSOM, *The Department of General Biology, Vanderbilt University, Nashville 37235*; O. F. FRANCKE, *The Museum and Department of Biological Sciences, Texas Tech University, Lubbock 79409*. Received 24 September 1982, accepted 5 January 1983.

PUBLICATIONS OF THE MUSEUM
TEXAS TECH UNIVERSITY

Three publications of The Museum of Texas Tech University are issued under the auspices of the Dean of the Graduate School and Director of Academic Publications, and in cooperation with the International Center for Arid and Semi-Arid Land Studies. Short research studies are published as Occasional Papers whereas longer contributions appear as Special Publications. Papers of practical application to collection management and museum operations are issued in the Museology series. All are numbered separately and published on an irregular basis.

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ISSN 0149-175X
Texas Tech Press
Lubbock, Texas 79409

OCCASIONAL PAPERS THE MUSEUM TEXAS TECH UNIVERSITY

NUMBER 89

4 NOVEMBER 1983

ASPECTS OF THE THERMAL BIOLOGY OF THE BOLSON TORTOISE, *GOPHERUS FLAVOMARGINATUS*

FRANCIS L. ROSE

There are four extant species of tortoises in North America (*Gopherus agassizii*, *G. berlandieri*, *G. flavomarginatus*, *G. polyphemus*). *G. polyphemus* inhabits mesic regions of the southeastern United States, but the other three species inhabit xeric regions of the southwestern United States and northern Mexico. Despite the fact that these tortoises are a conspicuous component of their environment, until recently little was known about their thermal biology. Woodbury and Hardy (1948), McGinnis and Voigt (1971), and Voigt (1975) reported thermal values for *G. agassizii*; Judd and Rose (1977) and Voigt and Johnson (1976) reported thermal values for *G. berlandieri*; and Douglass and Layne (1978) reported data accumulated during an 8-year study of *G. polyphemus*. The critical thermal maxima were determined for *G. agassizii* and *G. berlandieri* (Hutchison *et al.*, 1966; Brattstrom, 1965; Judd and Rose, 1977). Lowe *et al.* (1971) reported freezing points and supercooling limits of *G. agassizii* and *G. berlandieri*, and Spray and May (1972) reported heating and cooling rates of four species of chelonian, including *G. polyphemus*. No data have been published on the thermal biology of *G. flavomarginatus*.

The bolson tortoise, *G. flavomarginatus*, is the largest terrestrial chelonian occurring naturally in North America. Because of its restrictive range in an inhospitable environment and its secretive behavior, few data have been published on its biology. The species inhabits a limited area of about 10,000 km² in northern Mexico (southwest Coahuila, southeast Chihuahua, and northeast

